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# Social determinants of HPV vaccination delay rationales: Evidence from the 2011 National Immunization Survey–Teen

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## ABSTRACT

**Objective.** To examine social variations in parental rationales for delaying or forgoing human papillomavirus vaccination in their U.S. adolescent children.

**Methods.** Using data from the 2011 National Immunization Survey–Teen, we estimated a series of binary logistic regression models to predict the odds of reporting (1) any vaccine delay ( $n = 25,229$ ) and (2) specific rationales among parents who reported that they were “not likely at all” to vaccinate their teen ( $n = 9,964$ ).

**Results.** The odds of not receiving a recommendation to vaccinate were higher in parents of boys ( $OR = 2.57$ ;  $CI = 2.20–3.01$ ). The odds of reporting a lack of knowledge were higher in parents who identified as Hispanic ( $OR = 1.39$ ;  $CI = 1.11–1.72$ ), Black ( $OR = 1.49$ ;  $CI = 1.19–1.85$ ), and other races ( $OR = 1.43$ ;  $CI = 1.13–1.80$ ) than parents who identified as non-Hispanic White. Socioeconomic disparities in parental rationales for delaying human papillomavirus vaccination in their teen children were sporadic and inconsistent.

**Conclusion.** Our results suggest that interventions should focus on increasing information about the benefits of the human papillomavirus vaccine among parents of minority youth. Our findings also suggest that interventions targeting health care providers may be a useful strategy for improving vaccine uptake among adolescent males.

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## Introduction

Human papillomavirus (HPV), which can cause cervical cancer, genital warts, and other anogenital cancers, is the most common sexually transmitted infection in the United States (Weinstock et al., 2004). Among females 14–59 years of age, over a quarter are infected with at least one strain of HPV (Dunne et al., 2007). The virus is also prevalent among sexually active males (Dunne et al., 2006). Recent estimates suggest that oral HPV infection, which is the cause of a subset of oropharyngeal squamous cell carcinomas (OSCCs) (Gillison et al., 2000), is more common in men than in women (Gillison et al., 2012). In 2006, a three-dose vaccine was approved for use among females age 9–26 years (Centers for Disease Control and Prevention, 2007). HPV vaccine guidelines were extended to males beginning in October of 2009, with a routine vaccination recommendation beginning in October 2011 (Centers for Disease Control and Prevention, 2010).

Although rates of vaccination among adolescent girls have more than doubled since the vaccine's introduction, current estimates suggest that progress may be slowing, as there was little change in vaccine uptake between 2011 and 2012. Most recent estimates suggest that only one in three adolescent girls have received all three recommended doses (Centers for Disease Control and Prevention, 2013). Vaccination rates among adolescent boys are especially low, with fewer than one in ten receiving any doses of the HPV vaccine (Reiter et al., 2013c). Such low rates of uptake are disheartening given evidence of the vaccine's effectiveness. Within 4 years of introduction, the vaccine-type HPV prevalence decreased markedly among adolescent girls (Markowitz et al., 2013).

Research suggests that cervical cancer screening, diagnosis, treatment, and survival vary widely according to sociodemographic characteristics (Akers et al., 2007; Newmann and Garner, 2005). Socioeconomic deprivation is associated with increased risk of developing cervical cancer, delayed treatment of the disease, and a higher mortality rate (Akers et al., 2007; Parikh et al., 2003; Singh et al., 2004). African Americans and Hispanics exhibit higher rates of cervical cancer than their non-Hispanic White counterparts (Centers for Disease Control and Prevention, 2012; American Cancer Society, 2013). Rather than reducing social disparities in HPV infection and cervical cancer mortality, the HPV vaccine could potentially increase disparities according to race,

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ethnicity, and socioeconomic status. African American and Hispanic females appear to be less likely than their non-Hispanic White counterparts to have initiated (Fisher et al., 2013; Gelman et al., 2013; Kessels et al., 2012) and completed (Dempsey et al., 2011; Kessels et al., 2012; Kester et al., 2013; Polonijo and Carpiano, 2013) the three-dose HPV vaccine series. There is some research to suggest an inverse relationship between parental socioeconomic status and HPV vaccination among adolescents (Kester et al., 2013; Polonijo and Carpiano, 2013; Tiro et al., 2012), but this finding is inconsistent in the literature (Fisher et al., 2013; Kessels et al., 2012). Social variations in HPV vaccination uptake among boys are largely unexplored; however, limited evidence suggests that non-Hispanic White parents are less likely to have vaccinated sons than parents of other racial and ethnic groups (Reiter et al., 2013c).

Although social determinants of HPV vaccination initiation are relatively well established, research has just begun to identify prevalent rationales for delaying HPV vaccination, including, for example, not receiving a recommendation to vaccinate (Darden et al., 2013; Dorell et al., 2011; Holman et al., 2014; Kester et al., 2013; Reiter et al., 2013a), reporting that the child was not sexually active (Caskey et al., 2009; Darden et al., 2013), safety concerns (Caskey et al., 2009; Darden et al., 2013), and a lack of knowledge about the vaccine (Dorell et al., 2011; Holman et al., 2014; Reiter et al., 2013a,b). While this new line of research is informative, few studies have tested whether any of these rationales for postponing or forgoing HPV vaccination are likely to vary according to socioeconomic status (SES), race, ethnicity, and gender.

Polonijo and Carpiano (2013) note important social inequalities in both HPV vaccine knowledge and receipt of a health provider's recommendation to vaccinate. More specifically, they find that low SES and racial/ethnic minority parents display lower odds of knowing about the vaccine. Further, African American and low SES parents are less likely to receive a recommendation from a health professional to vaccinate their daughters. Other research focusing on adolescents in North Carolina suggests that parents of boys are less likely to receive a recommendation to vaccinate than parents of girls (Gilkey et al., 2012). These disparities suggest that other important social variations may exist in reasons for delay in HPV vaccine uptake. Understanding not only *who* delays HPV vaccination, but *why* certain individuals postpone receiving this critical vaccine may allow public health officials to design more effective interventions focused on addressing the concerns of certain at-risk subpopulations.

Using data collected from a large, nationally representative sample of parents of adolescent children, we test whether parental rationales for delaying HPV vaccination in their teen children vary according to gender, race/ethnicity, and socioeconomic status. Previous research identifying key parental reasons for delaying or forgoing adolescent HPV vaccination has been largely descriptive in nature (Darden et al., 2013; Kester et al., 2013; Reiter et al., 2013a). While this research is an important first step in understanding why parents may postpone or refuse the HPV vaccine, it does not allow us to identify important subgroup variations in rationales. Further, much of the research on HPV attitudes and uptake focuses solely on females (Caskey et al., 2009; Cassidy and Schlenk, 2012; Conroy et al., 2009; Constantine and Jerman, 2007; Dempsey et al., 2011; Kohler et al., 2008; Reiter et al., 2009; Rosenthal et al., 2008; Tiro et al., 2012; Wei et al., 2013), utilizes small, community samples (Adams et al., 2007; Cassidy and Schlenk, 2012; Conroy et al., 2009; Gerend et al., 2009; Manhart et al., 2011; Read et al., 2010; Reiter et al., 2009, 2013b; Rosenthal et al., 2008; Vanderpool et al., 2011), or centers on specific subpopulations (Guerry et al., 2011; Perkins et al., 2013; Read et al., 2010). While informative, results from these studies cannot be generalized beyond these population parameters. Previous research has also noted social disparities in important predictors of HPV vaccination, such as HPV knowledge and provider recommendation; however, the current study is the first to examine (a) social variations in a wide range of rationales for delaying or forgoing HPV vaccination and (b) whether social disparities in these

rationales explain why parents chose to delay or forgo HPV vaccination in their adolescent children.

## Methods

### Data

Our study employs data from the 2011 National Immunization Survey–Teen (NIS-Teen). The National Center for Immunization and Respiratory Diseases and the National Center for Health Statistics collected the telephone survey data from a random digit sample of parents of adolescent children. The NIS-Teen survey implemented a dual-frame sampling design with independent landline and cell phone samples. Response rates for these samples are 57.2% and 22.4%, respectively. The primary aim of the NIS-Teen is to estimate vaccine coverage for adolescents aged 13–17 based on parental reports. Within recruited households, the parent or guardian who reported knowing the most about the adolescent's health was administered a survey asking about the child's vaccine history. With only a few rare exceptions (e.g., emancipated minors), teens under 18 must have parental consent in order to receive the HPV vaccine. Thus, parental reports are preferable for this age group.

In the first set of analyses, we examine the social distribution of parental reports of vaccine delay. We limited our sample to parents of those teens who had not yet initiated the HPV vaccination series ( $n = 25,229$ ). In the second set of analyses, we limited our sample to those respondents who reported that they were “not likely at all” to have their child vaccinated in the next twelve months ( $n = 9,964$ ). All estimates were weighted using the protocol for the dual-frame sample weight detailed in the user guide, which can be found online (Data User's Guide for the 2011 NIS-Teen Public Use Data File, 2011)

### Measures

Parents who reported that their teen had not yet received any doses of the HPV vaccine were asked how likely it was that their child would receive the vaccine in the next 12 months. Response categories for this question ranged from “very likely” to “not likely at all” on a 5-point scale. Responses to this question were used to create a dichotomous indicator of those parents who were “not likely at all” to have their child vaccinated in the next year. Parents who did not plan to vaccinate their teen were asked to report the main reason(s) for delay by selecting from a list of eight response categories. Using these measures, we created a series of dichotomous variables to indicate the various rationales for delaying or forgoing the HPV vaccine, including no recommendation, safety concerns, no perceived need, the teen is male, lack of knowledge about the vaccine, the teen is not sexually active, age, and “other” reasons. Parents who reported “other” were asked to specify their reasoning, and responses were back coded by NIS-Teen. Parental reasons for vaccine delay that included less than 2 percent of the sample were included in the “other” category. The other category includes reasons such as religion and cost of the vaccine. Although respondents had the option of selecting more than one reason for forgoing the vaccine, the majority of the sample reported only one reason (92.3%).

While social variations in rationales for HPV vaccination delay are largely unexplored, prior research has identified a number of correlates of HPV vaccine acceptability and uptake that may help identify barriers to HPV vaccine initiation, including the child's sex, race and ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic, other race), age, maternal education (less than high school, high school degree, some college, college or higher), and household income (living at or below poverty level, greater than poverty but less than \$75,000, greater than or equal to \$75,000). We also include controls for a number of other potential confounding variables, including insurance status (privately insured, Medicaid, no insurance), the relationship of the respondent to the child, the number of children in the household, the respondent's

marital status (currently married, other status), maternal age (34 years or younger, 35–44 years, 45 years or older), and the region of residence (South, Midwest, West, Northeast).

## Results

Descriptive statistics for all measures are presented in Table 1. The first column displays information on sample characteristics for the full sample. Column 2 provides information on the subsample of adolescents who have not initiated the HPV vaccine. Among parents of teens who had not yet initiated the vaccine series, a substantial percentage reported that they were not likely at all to do so in the next year (40.3%). The majority of the full sample were parents of unvaccinated sons (65.2%), non-Hispanic White (69.5%), married (78.3%), covered by private insurance (85.9%), and living well above the poverty line. The typical respondent was the child's mother (79.1%), 45 years or older (52%) with at least some college education (28.2%). Among those parents who did not intend to vaccinate their teen, the most common reason reported was a belief that the vaccine was not needed (28.8%), followed by reports that their teen is not sexually active (18.2%). Other parents reported that they did not intend to vaccinate because they had not received a recommendation for the HPV vaccine from their doctor or other medical professional (12.6%), had concerns about the safety of the vaccine (12.5%), or felt they did not know enough about the HPV vaccine (10%). A small minority of respondents reported that they did not intend

to vaccinate because their teen is male (9.2%) or too young (5.6%). Finally, approximately 9% of the sample reported some other reason for delaying or forgoing the HPV vaccine. In comparing the characteristics of the delay sample with the full sample, those who intended to delay were disproportionately non-Hispanic White, more affluent, and more highly educated.

Table 2 presents the results of a logistic regression model predicting the odds of parental reports of being “not likely at all” to vaccinate their teen within the next 12 months. Among unvaccinated teens, males displayed an approximate 20% increase (OR = 0.67; CI = 0.62–0.73) in the odds of continued vaccination delay (OR = 1.20; CI = 1.14–12.7) in comparison to their female counterparts. Both Hispanic teens and those adolescents in the “other” race category (OR = 0.85; CI = 0.77–0.93) displayed lower odds of reporting a further delay in HPV vaccination uptake in comparison to non-Hispanic White adolescents. Interestingly, adolescents in households with higher levels of income displayed greater odds of delaying vaccination in comparison to those teens in households with incomes at or below the poverty line. Similarly, greater maternal education was associated with increased odds of continued vaccination delay. Teens with mothers who had less than a high school education (OR = 0.55; CI = 0.48–0.63) or only a high school education (OR = 0.88; CI = 0.82–0.94) displayed lower odds of further vaccination delay as compared to those youths with college educated mothers.

Parents who reported that they were “not likely at all” to vaccinate their child in the following twelve months were asked the primary reason for delaying or forgoing the vaccine. As shown in Table 3, there were notable gender variations in rationales for delaying HPV vaccination. Parents of boys were more than twice as likely to report not receiving a recommendation to vaccinate as the primary reason for delaying vaccination (OR = 2.57; CI = 2.20–3.01) in comparison to parents of girls. Likewise, parents of sons displayed increased odds of delaying or

**Table 1**  
Demographic and descriptive statistics, National Immunization Survey–Teen, 2011 U.S.

	Full sample (SD)	Delay sample (SD)
Vaccine delay	40.3	
Reported reason for delay		
No recommendation		12.6
Safety concern		12.5
No need for the vaccine		28.8
Lack of knowledge		10.0
Teen is not sexually active		18.2
Teen's age		5.7
Other		8.7
Teen is male		9.2
Male	65.2	67.5
Race/ethnicity		
Hispanic	12.2	9.2
Black	9.9	9.0
Other	8.4	7.9
Non-Hispanic White	69.6	73.9
Age	14.9 (1.4)	14.9 (1.4)
Federal poverty level (FPL)		
>= 75 k	45.2	48.2
Greater than poverty, less than 75 k	41.7	43.0
Below federal poverty level	13.1	8.8
Mother's education		
Less than high school	7.7	4.2
High school only	19.1	17.5
Some college	28.2	29.9
College graduate	44.9	48.3
Insurance status		
Privately insured	85.9	87.7
Medicaid	6.4	4.8
No insurance	7.6	7.5
Mother respondent	79.1	79.9
Number of children in household	1.7 (0.6)	1.71 (0.6)
Married	78.3	81.2
Mother's age (years)		
35 or younger	6.2	5.7
35–44	41.8	42.3
≥ 45	52.0	52.5
Census region		
South	38.7	37.4
Midwest	21.0	22.1
West	22.6	23.6
Northeast	17.8	16.9
	n = 25,229	n = 9,964

**Table 2**  
Logistic regression of reporting “not likely” to initiate vaccination sequence in next 12 months, National Immunization Survey–Teen, 2011 U.S.

	OR	95 % CI
Male	1.20***	1.14–1.27
Race <sup>a</sup>		
Hispanic	0.67***	0.62–0.73
Black	0.93	0.84–1.01
Other	0.85***	0.77–0.93
Age	0.98	0.96–1.00
Household income <sup>b</sup>		
≥ 75 k	1.37***	1.23–1.53
Greater than poverty, less than 75 k	1.49***	1.33–1.61
Mother's education <sup>c</sup>		
Less than high school	0.55***	0.48–0.63
High school only	0.88***	0.82–0.94
Some college	1.02	0.95–1.08
Mother respondent	1.07*	1.01–1.15
Number of children in household	1.11***	1.06–1.15
Married	1.15***	1.08–1.24
Mother's age (years) <sup>d</sup>		
35–44	1.17**	1.04–1.29
≥ 45	1.16*	1.02–1.27
Insurance coverage <sup>e</sup>		
Medicaid	0.88*	0.78–0.98
No insurance	1.06	0.95–1.17
Census region <sup>f</sup>		
South	1.11**	1.03–1.19
Midwest	1.17***	1.08–1.27
West	1.23***	1.14–1.33
Constant	0.34***	
N = 25,229		

Note. OR = odds ratio. Omitted categories: <sup>a</sup>White (non-Hispanic), <sup>b</sup>poverty or less, <sup>c</sup>college degree, <sup>d</sup>less than or equal to 34 yrs, <sup>e</sup>employer, <sup>f</sup>northeast. \**p* < 0.05, \*\**p* < 0.01, \*\*\**p* < 0.001.

**Table 3**

Logistic regression of rationales for delaying HPV vaccination uptake, National Immunization Survey–Teen, 2011 U.S.

	No recommendation		Safety concerns		No need		Lack of knowledge	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Male	2.57***	2.20–3.01	0.28***	0.24–0.31	1.22***	1.10–1.34	1.08	0.94–1.25
Race <sup>a</sup>								
Hispanic	1.14	0.91–1.38	1.14	0.91–1.35	0.99	0.85–1.15	1.39**	1.11–1.72
White	1.11	0.85–1.31	0.77*	0.65–0.92	1.20*	1.03–1.39	1.49***	1.19–1.85
Other	1.41**	1.13–1.73	0.72**	0.56–0.92	1.00	0.85–1.18	1.43**	1.13–1.80
Age	1.01	0.98–1.07	1.02	0.97–1.07	1.02	0.98–1.05	1.03	0.98–1.08
Household income <sup>b</sup>								
Greater than or equal to 75 k	1.01	0.79–1.29	1.30	0.99–1.70	1.07	0.88–1.29	0.94	0.71–1.22
Greater than poverty, less than 75 k	0.87	0.70–1.09	1.33*	1.03–1.70	1.16	0.95–1.31	0.96	0.74–1.22
Mother's education <sup>c</sup>								
Less than high school	0.99	0.82–1.46	0.96	0.68–1.35	1.06	0.84–1.34	1.29	0.97–1.79
High school only	1.00	0.83–1.19	1.07	0.89–1.29	1.13	0.99–1.28	1.17	0.96–1.42
Some college	0.85*	0.73–0.99	1.06	0.91–1.23	1.01	0.91–1.12	1.10	0.94–1.29
Mother respondent	0.68***	0.59–0.78	1.74***	1.45–2.08	0.75***	0.67–0.83	1.21*	1.02–1.44
Number of children in household	0.96	0.89–1.06	1.06	0.96–1.18	1.08*	1.00–1.63	0.93	0.83–1.04
Married	0.99	0.83–1.15	0.91	0.78–1.07	1.18**	1.05–1.34	1.07	0.90–1.28
Mother's age (years) <sup>d</sup>								
35–44	1.25	0.91–1.472	0.98	0.75–1.29	0.98	0.81–1.18	1.14	0.84–1.56
≥45	1.35	0.97–1.86	0.91	0.69–1.20	0.97	0.80–1.19	0.96	0.70–1.33
Insurance status								
Medicaid	1.14	0.84–1.54	1.25	0.93–1.67	0.97	0.78–1.21	0.97	0.71–1.33
No insurance	0.85	0.67–1.09	0.89	0.70–1.14	1.10	0.94–1.31	1.09	0.85–1.39
Census region <sup>e</sup>								
South	0.78**	0.66–0.93	0.93	0.78–1.00	1.11	0.97–1.25	0.94	0.78–1.14
Midwest	1.04	0.59–0.87	0.83	0.69–1.00	1.08	0.94–1.25	0.85	0.68–1.04
West	0.73**	0.60–0.88	0.75**	0.62–0.91	1.31***	1.14–1.51	0.79*	0.64–0.98
Constant	0.08***		0.12***		0.19***		0.06***	
N = 9,964								
	Not sexually active		Teen's age		Other reason		Teen is male	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Male	0.68***	0.61–0.75	0.64***	0.54–0.77	0.54***	0.47–0.63	–	–
Race <sup>a</sup>								
Hispanic	0.72**	0.59–0.88	1.23	0.92–1.65	0.81	0.62–1.05	0.81	0.62–1.06
Black	0.83	0.68–1.00	0.62*	0.42–0.91	0.84	0.65–1.10	0.83	0.64–1.09
Other	0.81*	0.66–0.98	0.95	0.68–1.31	1.12	0.88–1.45	0.75	0.56–1.01
Age	0.94**	0.91–0.98	0.56***	0.52–0.61	1.14***	1.09–1.21	1.05*	1.01–1.11
Household income <sup>b</sup>								
≥75 k	0.86	0.69–1.07	1.23	0.84–1.82	0.62**	0.46–0.82	1.32	0.96–1.83
Greater than poverty, less than 75 k	0.92	0.75–1.13	0.97	0.67–1.40	0.84	0.65–1.09	1.11	0.83–1.51
Mother's Education <sup>c</sup>								
Less than high school	0.78	0.58–1.04	1.31	0.84–2.05	0.93	0.65–1.33	0.74	0.48–1.14
High school only	0.73***	0.62–0.86	0.91	0.69–1.20	0.97	0.79–1.19	0.72**	0.58–0.90
Some college	0.99	0.87–1.11	0.95	0.77–1.18	0.94	0.79–1.12	0.98	0.83–1.17
Mother respondent	1.08	0.95–1.23	1.25	0.99–1.57	1.19	0.99–1.44	1.50***	1.24–1.81
Number of children in household	1.01	0.93–1.11	0.93	0.79–1.08	0.91	0.81–1.03	1.05	0.93–1.18
Married	1.04	0.90–1.20	1.13	0.87–1.47	1.11	0.91–1.35	0.70***	0.58–0.85
Mother's age (years) <sup>d</sup>								
35–44	0.87	0.68–1.11	1.00	0.68–1.48	0.90	0.65–1.24	0.68*	0.50–0.94
>= to 45	1.08	0.84–1.40	1.10	0.74–1.64	0.74	0.53–1.04	0.68*	0.49–0.94
Insurance status								
Medicaid	0.99	0.79–1.29	0.92	0.57–1.49	1.06	0.76–1.48	0.98	0.67–1.41
No insurance	0.95	0.78–1.17	1.09	0.75–1.54	1.33*	1.04–1.70	0.97	0.74–1.29
Census region <sup>e</sup>								
South	1.05	0.91–1.23	0.77*	0.60–0.98	1.10	0.88–1.36	1.15	0.94–1.41
Midwest	0.96	0.81–1.14	0.91	0.70–1.19	1.09	0.86–1.37	0.93	0.74–1.17
West	1.13	0.95–1.32	0.70*	0.53–0.92	1.12	0.89–1.42	0.84	0.67–1.06
Constant	0.76		5.62***		0.03***		0.09***	
N = 9,964							N = 6,726	

Note. OR = odds ratio. Omitted categories: <sup>a</sup>White (non-Hispanic), <sup>b</sup>poverty or less, <sup>c</sup>college degree, <sup>d</sup>less than or equal to 34 yrs, <sup>e</sup>employer, <sup>f</sup>northeast. \**p* < 0.05, \*\**p* < 0.01, \*\*\**p* < 0.001.

forgoing the vaccine based on the belief that the vaccine was not needed (OR = 1.22; CI = 1.10–1.34) in comparison to parents of daughters. Conversely, parents of adolescent boys displayed lower odd of citing concerns about vaccine safety and side effects (OR = 0.28; CI = 0.24–0.31), a lack of sexual activity (OR = 0.68; CI = 0.61–0.75), or the child's age (OR = 0.64; CI = 0.54–0.77) as a reason for vaccination delay in comparison to parents of adolescent girls.

Our results also revealed notable racial and ethnic differences in reasons for delaying or forgoing the HPV vaccine. Black (OR = 0.77; CI = 0.65–0.92) and other race parents (OR = 0.72; CI = 0.56–0.92) both displayed reduced odds of citing safety concerns as the primary reason for delaying vaccination in comparison to non-Hispanic White parents. Conversely, African American parents (OR = 1.20; CI = 1.03–1.39) displayed greater odds of reporting that the delay in initiation



was because the HPV vaccine was not needed in comparison to their non-Hispanic White counterparts. Hispanic (OR = 1.39; CI = 1.11–1.72), Black (OR = 1.49; CI = 1.19–1.85), and other race (OR = 1.43; CI = 1.13–1.80) parents all displayed significantly higher odds of reporting that a lack of knowledge about the HPV was the primary barrier to adolescent vaccination in comparison to non-Hispanic White parents. Hispanic (OR = 0.72; CI = 0.59–0.88) and other race parents (OR = 0.81; CI = 0.66–0.98) displayed reduced odds of reporting that they were delaying or forgoing the vaccine because their child was not sexually active in comparison to non-Hispanic White parents. Black parents (OR = 0.62; CI = 0.42–0.91) displayed lower odds of reporting age as the reason for vaccine delay in comparison to non-Hispanic White parents.

Socioeconomic status was also associated with HPV rationales in our data. Those who reported “some college” as the level maternal education displayed reduced odds of selecting no recommendation (OR = 0.86; CI = 0.74–0.99), as the reason for delay in comparison to mothers with a college degree. Adolescents with high school educated mothers displayed reduced odds of receiving the vaccine due to being male (OR = 0.72; CI = 0.58–0.90), or not being sexually active (OR = 0.73; CI = 0.62–0.86), in comparison to mothers with a college degree. Parents with household incomes in the middle income category, above the federal poverty level but less than \$75,000, (OR = 1.28; CI = 1.00–1.63), displayed significantly greater odds of reporting safety concerns as a key reason for delaying HPV vaccination uptake in comparison to parents with lower incomes.

## Discussion

Social determinants of rationales for delaying or forgoing the HPV vaccine remain underexplored despite research noting significant variations in HPV vaccination initiation by gender, race/ethnicity, and socioeconomic status (Kester et al., 2013; Polonijo and Carpiano, 2013; Reiter et al., 2013c; Tiro et al., 2012). We examine these social variations in parental reasons for delaying the initiation of HPV vaccine in their adolescent children using data from the 2011 NIS-Teen, a nationally representative sample detailing vaccination coverage in United States among adolescents aged 13–17. Our results reveal a number of patterns of concern to practitioners interested in reducing social disparities in HPV vaccination uptake.

To begin, gender variations in HPV vaccination uptake appear to be driven by a lack of recommendation from health care professionals, with parents of boys being much less likely to receive a recommendation to vaccinate than parents of teen girls. Gender disparities in uptake are not surprising given that the recommendation to vaccinate against HPV was not extended to boys until 2009. However, a recent review suggests that both parents and medical professionals believe that the consequences of HPV infection are less severe for males than for females and therefore not worth the cost or effort of vaccinating against (Holman et al., 2014). Taken together with our findings, this research suggest that gender disparities in HPV vaccination uptake are unlikely to be reduced without substantial public health efforts to educate both parents and health care providers about the benefits of the vaccine and the potential health consequences of HPV infection for males.

Our results also revealed a number of racial and ethnic variations in rationales for delaying or forgoing the HPV vaccine. Hispanic, African American, and other race parents all displayed increased odds of reporting that a lack of knowledge about the HPV was the primary barrier to vaccination in comparison to non-Hispanic White parents. Racial and ethnic minority parents were also less likely to give other reasons (e.g., the child's age or safety concerns). These findings suggest that interventions focused on educating the parents of minority youth on the benefits of the HPV vaccine may be successful in reducing current racial and ethnic disparities in initiation (Fisher et al., 2013; Gelman et al., 2013; Kessels et al., 2012) and completion (Dempsey et al., 2011; Kessels et al., 2012; Kester et al., 2013; Polonijo and Carpiano, 2013)

of the 3 dose HPV vaccine series, as well as similar disparities in cervical cancer (Centers for Disease Control and Prevention, 2012; American Cancer Society 2013). Reducing the delay in timing of HPV vaccination among African American teens is of critical importance given that African American adolescents transition to first sex earlier than teens of other racial and ethnic groups, and for prophylactic vaccination to be most effective it should occur prior to sexual initiation (Adams et al., 2007).

Finally, our results showed few socioeconomic differences in the reasons parents give for delaying HPV uptake in their adolescent children. The few sporadic findings revealed in our data favored lower socioeconomic parents, suggesting that a lack of knowledge about the vaccine or concerns about vaccine safety are not a major barrier to HPV vaccination among this group. In fact, results from both Tables 2 and 3 suggest that interventions centered on increasing HPV vaccination rates should focus on parents of higher socioeconomic status adolescents, who appear to have more concerns about the vaccine than their less educated and less affluent counterparts.

One important limitation of this research underscores the need for caution in interpreting these findings and the need for further research into the links between social characteristics and parental rationales for delaying or forgoing the HPV vaccine. Consistent with the majority of studies in this area (Dorell et al., 2011, 2014; Reiter et al., 2013a,c), we rely on parental reports of provider recommendations, which may be subject to recall bias.

Despite this limitation, our results revealed several notable and robust associations between key social characteristics and parental rationales for delaying or forgoing HPV vaccination in adolescent children. Because uptake of the HPV vaccine remains low, understanding social disparities in reasons for delaying vaccination is critical to designing interventions focused on alleviating the concerns of parents. Our results suggest that these interventions might specifically focus on increasing information about the benefits of the HPV vaccine among parents of minority youth—a group with elevated risk of acquiring HPV and developing cervical cancer. Our findings also suggest that interventions targeting health care providers may also be a useful strategy for improving vaccine uptake among adolescent males.

## Conflict of interest statement

The authors declare that there are no conflicts of interests.

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